



ILLINOIS SUSTAINABLE
TECHNOLOGY CENTER
PRAIRIE RESEARCH INSTITUTE

Overview of Indoor Climate Research and Training

Manohar Kulkarni, PE, PhD
Director

Illinois Sustainable Technology Center

October 16, 2012



©2011 University of Illinois Board of Trustees.
All rights reserved. For permission information,
contact the Illinois Sustainable Technology Center.

Outline

- **ISTC Mission**
- **ISTC Programs**
- **Indoor Climate Research and Training (ICRT)**
- **Q/A**

ISTC Reporting and Organization

- **University of Illinois OVCR**
- **Prairie Research Institute (“Home of the Surveys”): Water, Geological, Natural History, Archeological, and ISTC**
- **Illinois Sustainable Technology Center**
 - **Indoor Climate Research and Training (ICRT)**
 - **Emerging Technologies and Assistance (ETAP)**
 - **Applied Research on Industrial and Environmental Systems (ARIES)**
 - **Sponsored Research, Public Engagement, and Communications (SRPEC)**

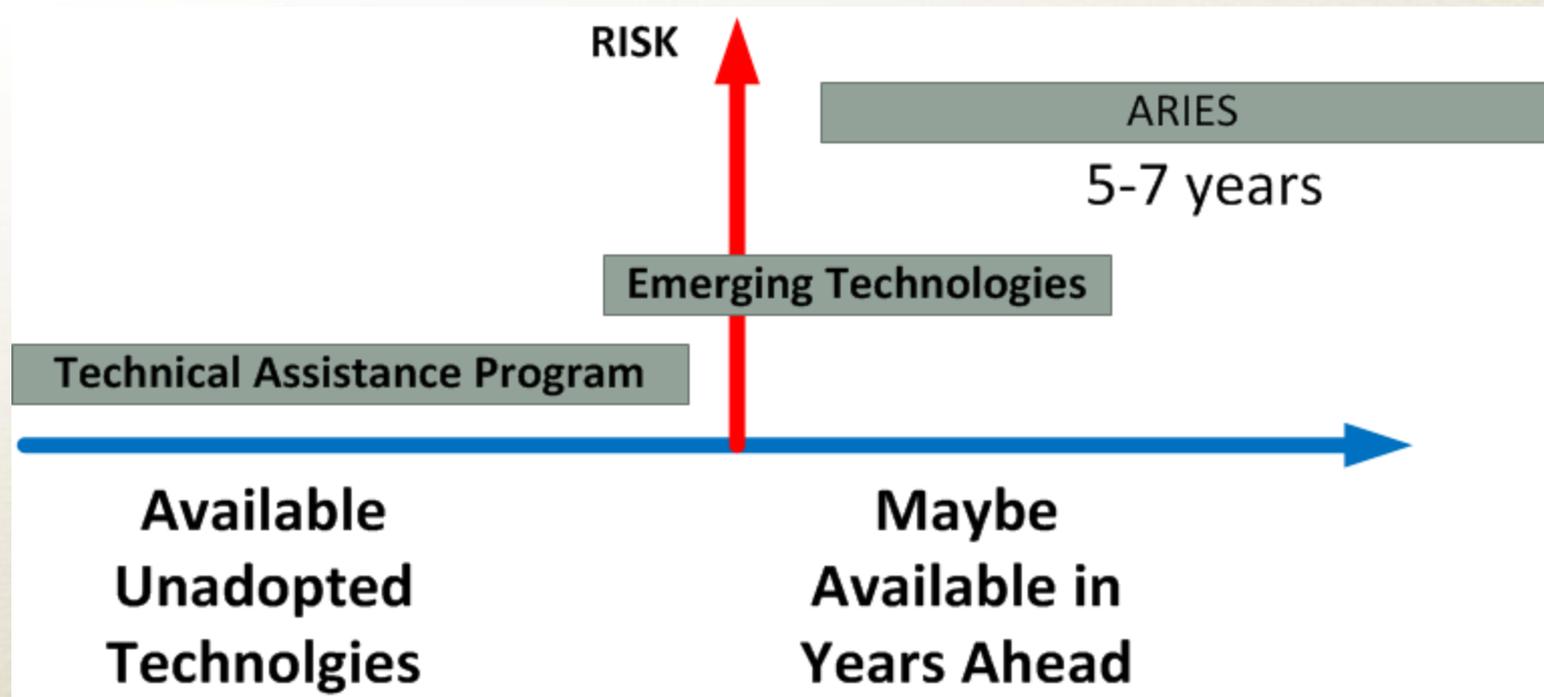
ISTC

- **Our State mandate is for,**
 - **Waste Reduction**
 - **Waste Management**
- **We consider ourselves as an Advocate for Energy and Environment**
- **We advance Sustainability through emerging technologies, technical assistance, and public engagement**

ISTC

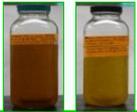
- **We have offices in Champaign, Chicago, Peoria, and Godfrey. That way we can outreach to industries and businesses all through Illinois.**
- **We have advanced laboratories and that is a unique strength we have when it comes to other technical assistance programs in the region or even nation. We focus on being a leader or partner in the sustainable research enterprise.**
- **Opportunities to leverage our efforts through other surveys, the campus, and beyond**

Applied vs. Emerging Technologies



Materials Use & Reuse

- Bio-oils/lubricants
- Biochar
- Plastics to Oil
- Supercapacitors
- Mud to Parks



Technical Assistance

- Waste Reduction
- Energy Reduction
- Water Conservation
- Indoor Climate Research & Training
- Manufacturing Process Improvement



Pollution Prevention

- Sustainable Electronics Initiative
- Environmental Fate and Transport
 - Pharmaceuticals and Personal Care Products (PPCPs)
 - Inorganics – Nutrients, Metals
 - Organics including Pesticides and Herbicides



Public Engagement

- Naturally Illinois Expo
- Governor's Sustainability Awards
- Sustainable Seminar Series
- Great Lakes Regional Pollution Prevention Roundtable
- Illinois Biochar Group
- Printers' National Environmental Assistance Center



**ILLINOIS SUSTAINABLE
TECHNOLOGY CENTER**
PRAIRIE RESEARCH INSTITUTE

Water Use & Reuse

- Membrane Technologies
- Desalinization
- Water Conservation
 - Wastewater Treatment Plants
 - Cooling Towers
 - Ethanol Plants



Technology Demonstrations

- Biodiesel
- Hydro Turbines
- Osmotic Desalinization



ISTC

Promoting sustainable practices within Illinois and beyond through

- **on-site technical assistance**
- **applied research (in-house/extra-mural)**
- **training and**
- **client engagement**

Indoor Climate Research and Training

- **In large part, the following slides are from Paul Francisco, Coordinator of ICRT**

ICRT History

- **Operate one of the DOE-funded Weatherization Training Centers**
 - **Contacted by Governor's office Dec. 2009**
 - **Governor's office provided 20% cost-share**
 - **Awarded Aug. 2010**
 - **Lease signed Oct. 2011**
 - **First class Nov. 2011**

ICRT Facility

- **Grand Opening celebration held TODAY!**
- **Outfitting of Training Center has continued since lease signing**
 - **Classroom construction**
 - **A/V**
 - **HVAC lab**
 - **Pressure diagnostic props**
 - **Ventilation**
 - **Air sealing**

Who We Are

- **Indoor Climate Research & Training**
- **Research**
 - Mainly residential
 - Energy efficiency
 - Health & safety
 - Building durability
- **Training**
 - Energy auditors
 - Contractors

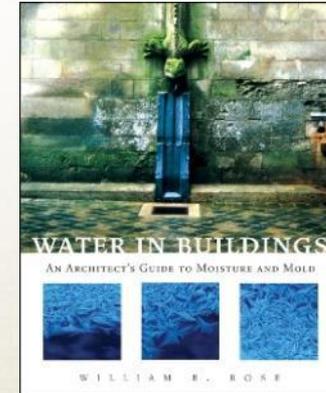


Who We Are

Paul Francisco



Who We Are



Bill Rose

Who We Are



Jeffrey Gordon

Who We Are



Zach Merrin



Indoor Climate

- **Energy use**
 - **Indoor air quality**
 - **Comfort**
- Indoor Environmental Quality**
- 

Research: HEALTH-V

- **When energy retrofits are done...**
- **...and different ventilation sizing strategies are used...**
- **...what is the impact on IAQ?**
- **...what is the impact on health outcomes?**



Research: Building America

- **Gas Technology Institute is team lead**
 - We are a team member
- **Annual task orders based on task proposals**



Research: National Weatherization Evaluation Project

- **Many field studies**
 - Bulk fuel energy savings
 - IAQ impacts
 - Process evaluation



- **Both research and training of field staff**

Research: Residential Lead Hazards



- Evaluation Illinois' of Get the Lead Out program
- EPA Research project to measure rehab worker's lead exposures
- Co-author of National Park Service "Lead Paint and Historic Buildings"
- **Current:** pilot project to reduce exposures thru window replacement

Research: Unvented Gas Fireplaces



Figure 1: Fireplace Use

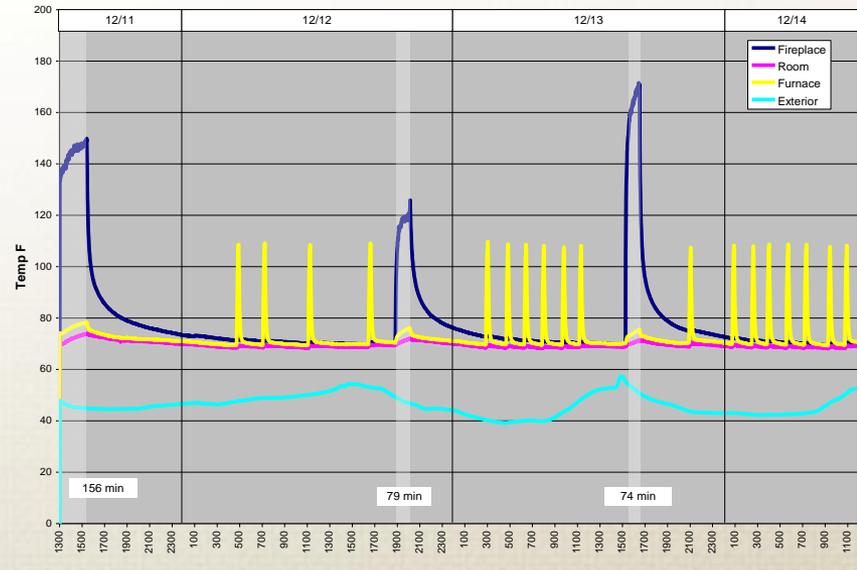
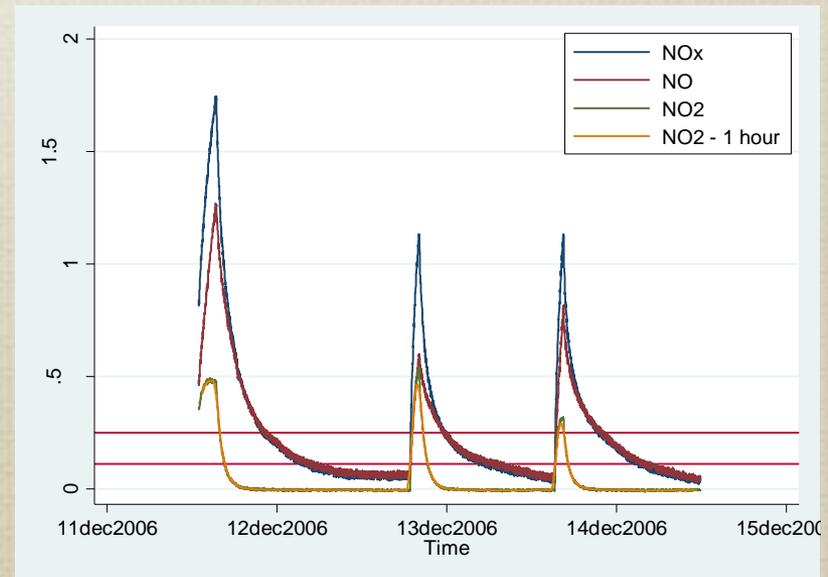
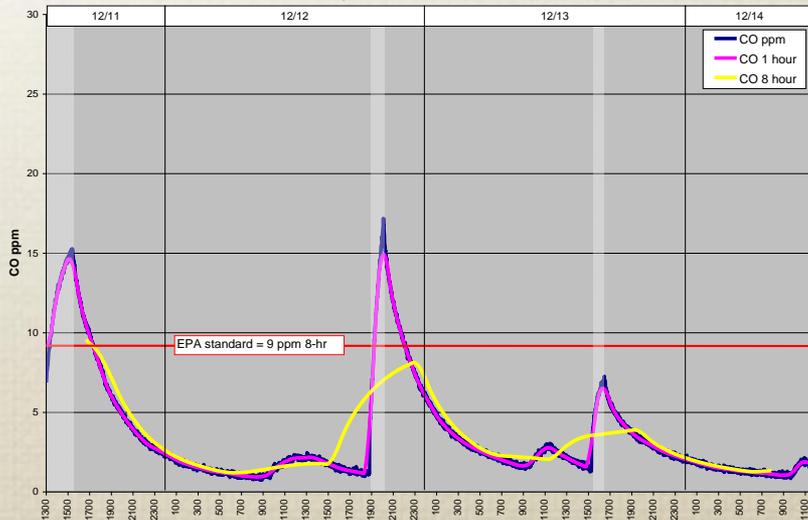
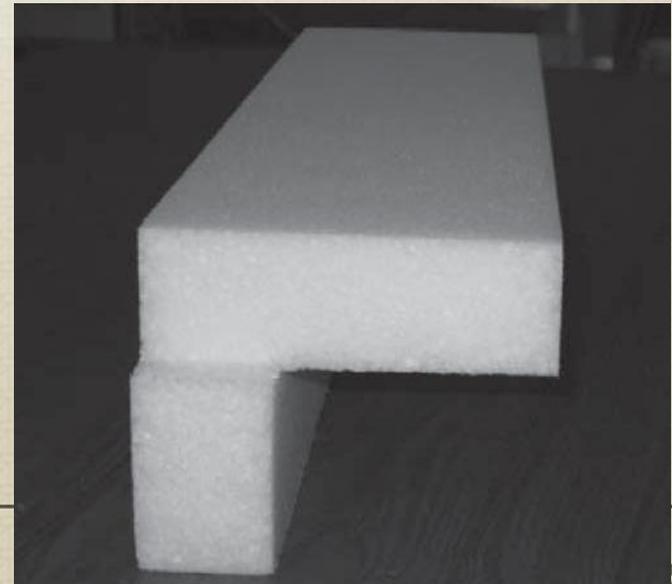


Figure 2: CO Concentration

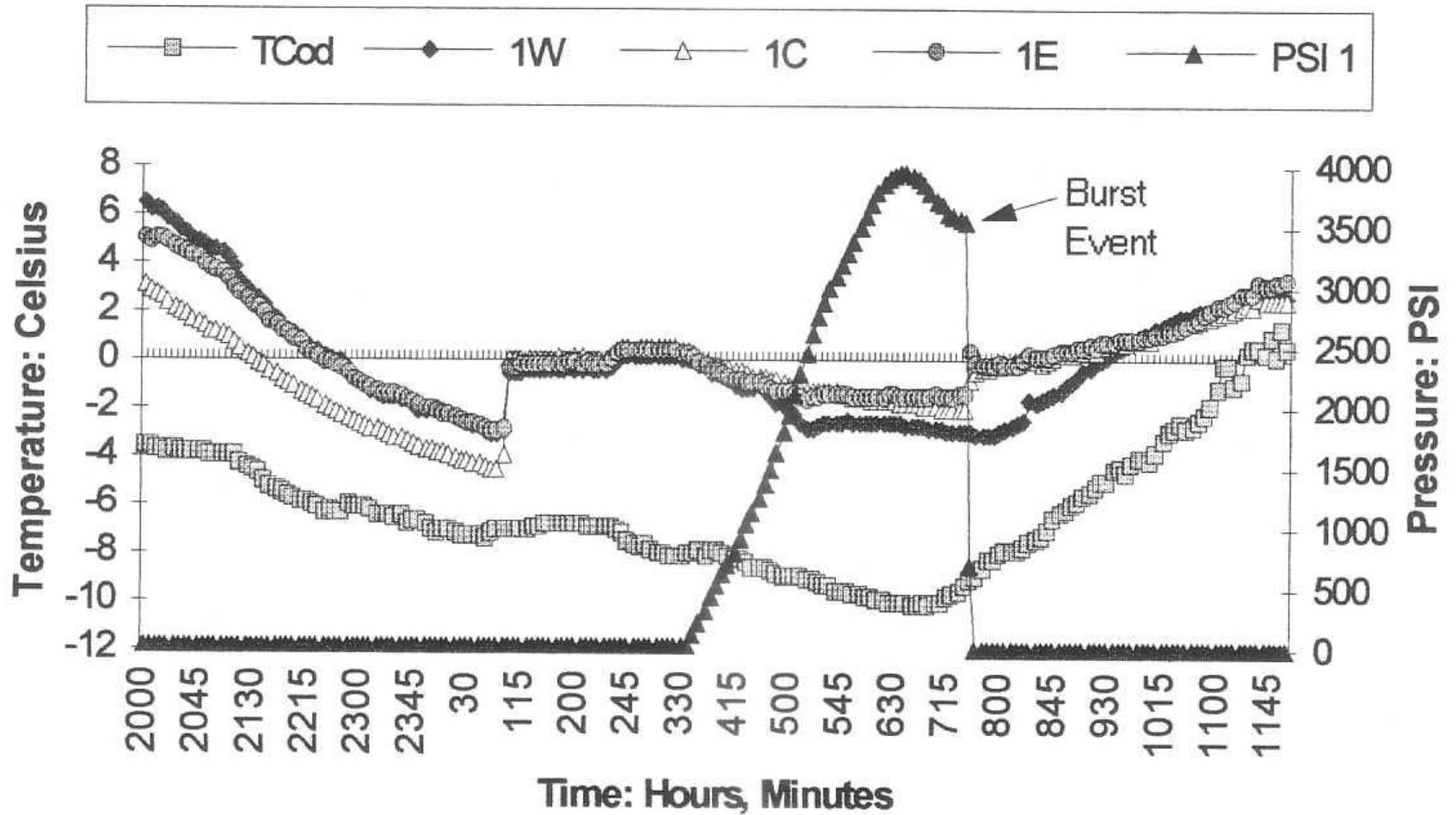


Research: Wall-Ceiling Junction



**Unfortunately, none of the methods
solved the problem**

Research: Pipe Bursting





Origins of building regulations

The 1/300 attic ventilation rule was proposed as a consequence of one data point in one study. “Condensation of moisture and its relation to building construction and operation” 1938. Frank Rowley, University of Minnesota.

TABLE XII
ATTIC VENTILATION

| Outside Air Temperature, Degrees Fahrenheit | Inside Air Conditions | | No Ventilation | | Natural Ventilation | | |
|---|-----------------------|----------------------------|---|---------------------------|-----------------------------------|---|---------------------------|
| | Degrees Fahrenheit | Per cent relative humidity | Attic air temperature, degrees Fahrenheit | Condensation ^a | Opening, square inch ^b | Attic air temperature, degrees Fahrenheit | Condensation ^a |
| +15 | 70 | 40 | 26.9 | 0.0 | 0.125 | 24.2 | 0.0 |
| +10 | 70 | 40 | 22.6 | 0.0 | 0.125 | 19.9 | 0.0 |
| + 5 | 70 | 40 | 17.3 | 1.16 | 0.125 | 13.9 | 0.0 |
| -10 | 70 | 40 | 3.9 | 2.38 | 0.125 | 0.2 | 0.53 |
| + 5 | 70 | 40 | 17.3 | 1.16 | 0.125 | 13.9 | 0.0 |
| + 5 | 70 | 30 | 17.6 | 0.78 | 0.125 | 14.6 | 0.0 |
| + 5 | 70 | 20 | 16.9 | 0.0 | 0.125 | 14.1 | 0.0 |
| -10 | 70 | 40 | 3.9 | 3.15 | 0.125 | 0.2 | 0.53 |
| -10 | 70 | 20 | 2.8 | 2.28 | 0.125 | 1.4 | 0.0 |
| -10 | 70 | 40 | 3.9 | 3.15 | 0.125 | 0.2 | 0.53 |
| -10 | 70 | 40 | 4.6 | 3.15 | 0.250 | 0.4 | 0.0 |
| 0 | 70 | 20 | 11.8 | 1.76 | 0.125 | 7.8 | 0.0 |
| -15 to +15 | 70 | 20 | | 0.0 | 0.063 | | 0.0 |
| + 5 | 70 | 30 | 17.6 | 0.78 | 0.125 | 14.6 | 0.0 |
| -15 to +15 | 70 | 30 | | 0.18 | 0.063 | | Trace |

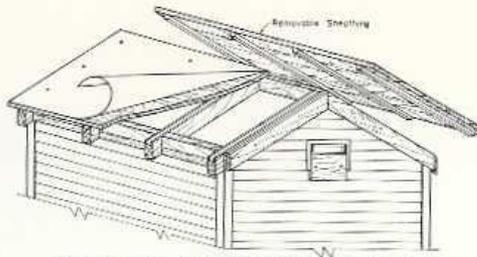


FIGURE 20. CONSTRUCTION DETAILS OF ATTIC FOR ATTIC VENTILATION TESTS

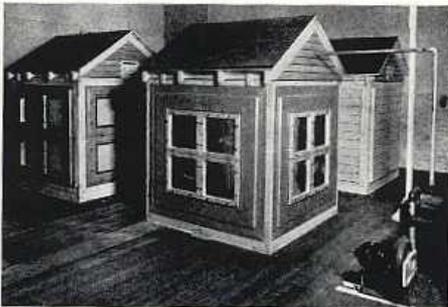


FIGURE 21. VIEW OF SETUP FOR VENTILATED AND UNVENTILATED ATTICS

^a Condensation in grams per square foot of ceiling area per 24 hours (1 gram=.0022 pound).
^b Opening in square inches in each gable per square foot of ceiling area.
^c Outside air supplied to attic space in cubic feet per hour per square foot of ceiling area.

Research: Attic Performance

- **Main conclusion: attic ventilation becomes inconsequential in attics with high R-value and tight ceilings.**



& Training

- **Mostly residential retrofit**
- **Focus on**
 - Building Diagnostics
 - Building Science
 - Cost-effectiveness
 - Health & Safety
- **Classroom and hands-on**



& Training

- **Curriculum Development**
 - **Architectural contractors**
 - **HVAC contractors**
 - **Assessors**
 - **Alignment with program rules**



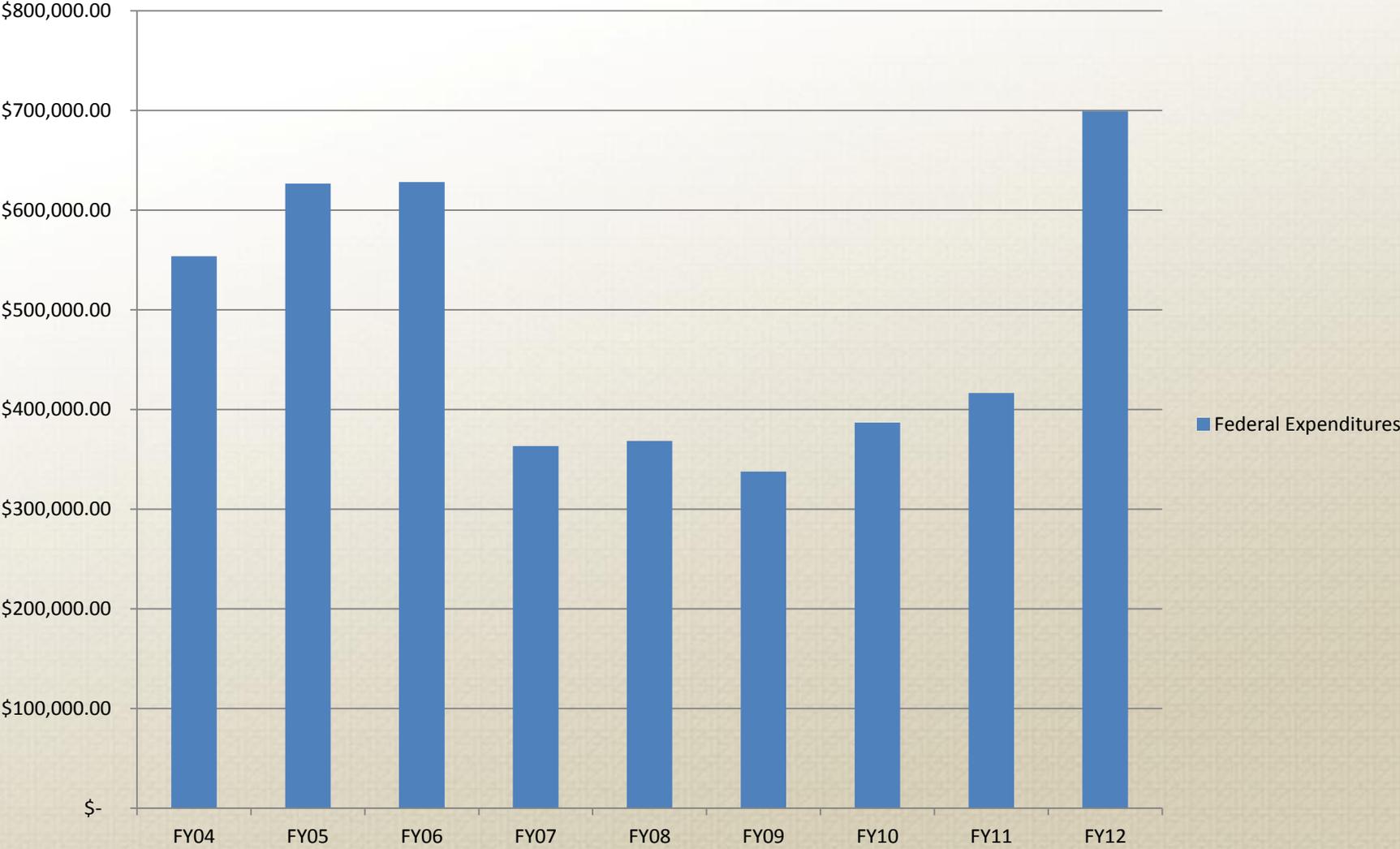
Training by the Numbers

- **Last year about 300 individuals who took 900 different classes**
- **A state of the art 6,700 square foot training facility**
- **Has a HVAC Mobile Training Laboratory and an Insulation Training Truck**
- **Over the five years about 600 individuals who took 2,500 different classes**

Training by the Numbers

- **Part of a larger DCEO effort, Illinois Home Weatherization Assistance Program (IHWAP)**
- **Over the last three years the program has weatherized over 42,000 homes, with nearly 20,000 homes weatherized in the past year.**
- **Weatherization typically reduces household energy consumption by 12 to 25 percent and improves indoor environmental health and safety according to DCEO.**

Federal Expenditures by Margaret Morrison



ISTC Sponsored Project Expenditures by Margaret Morrison



Public Service

Courtesy Copy. © 2010 ASHRAE. For personal use only. In accordance with international copyright law, recipients may not distribute this file in electronic, use in paper form without expressed written permission of ASHRAE.

ANSI/ASHRAE Standard 62.2-2010
(Supersedes ANSI/ASHRAE Standard 62.2-2007)
Includes ANSI/ASHRAE addenda listed in Appendix B



ASHRAE STANDARD

Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings

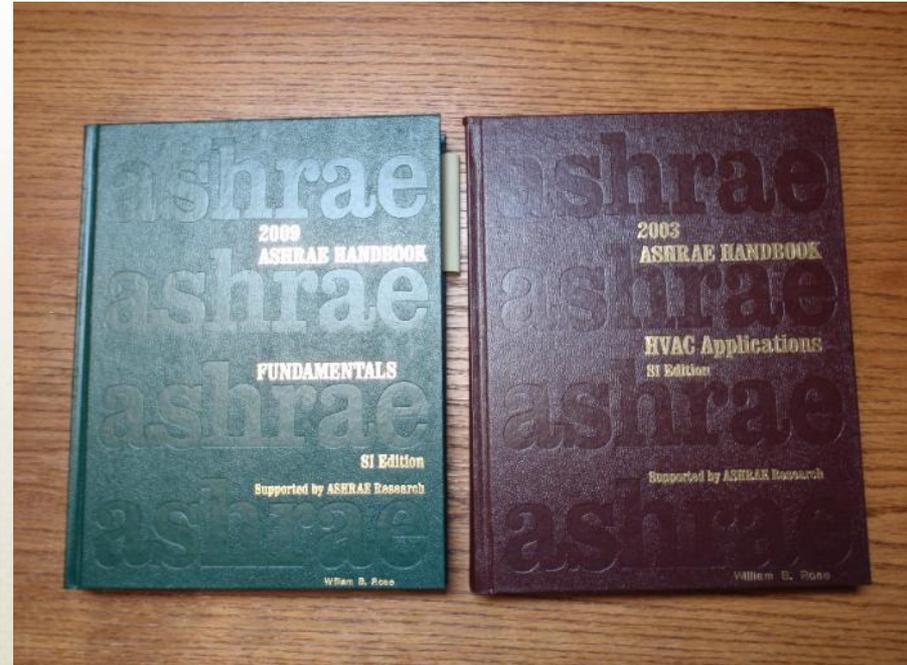
See Appendix B for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submit form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site (www.ashrae.org) or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE Web site (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-521-5478. Telephone: 404-496-8400 (worldwide), or toll free 1-800-507-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

© Copyright 2010 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
ISSN 1041-2336



American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle NE, Atlanta, GA 30329
www.ashrae.org



- Building Performance Institute BoD
- Advisory committees for weatherization

Future Directions

- **Interstate Renewable Energy Council (IREC) accreditation of the Training Center**
- **Comprehensive building science curriculum**
- **More research, e.g.**
 - **Radon?**
 - **Combustion and IAQ, expanding to biomass?**
 - **Ventilation and health?**



ILLINOIS SUSTAINABLE
TECHNOLOGY CENTER
PRAIRIE RESEARCH INSTITUTE

Thank You!
Any Questions?

Manohar Kulkarni, PhD, PE

kulkarni@illinois.edu

217-333-8569